

CLAIMS

[1] A retroreflective sheet comprising a surface layer including at least one layer, a focusing layer containing glass spheres, and a metal reflective layer on the back side of the focusing layer,

5 wherein the glass spheres are disposed at random locations in the thickness direction of the focusing layer.

[2] The retroreflective sheet according to Claim 1, wherein the glass spheres include a glass sphere group B in contact with the surface layer, and a glass sphere group A located away from the surface layer, and the glass
10 sphere group A exhibits retroreflective performance at a larger observation angle than the observation angle of the glass sphere group B.

[3] The retroreflective sheet according to Claim 1, wherein the glass spheres include a glass sphere group B in contact with the surface layer, and a glass sphere group A located away from the surface layer, and
15 the metal reflective layer of the glass sphere group B is formed at a focus formation position, the thickness of the focusing layer of the glass sphere group A is less than the thickness of the focusing layer of the glass sphere group B, and the glass sphere group A exhibits retroreflective performance at a relatively larger observation angle than the glass sphere
20 group B.

[4] The retroreflective sheet according to Claim 1, wherein the glass spheres include a glass sphere group B in contact with the surface layer, and a glass sphere group A located away from the surface layer, and
the focusing layer formed in the form of concentric circles on the glass
25 sphere surfaces of the glass sphere group B has a thickness at which the maximum reflective performance is exhibited at an observation angle of 0.2° and an incidence angle of 5° , the thickness of the focusing layer of the glass sphere group A is less than the thickness of the focusing layer of the glass

sphere group B, and the glass sphere group A exhibits retroreflective performance at a relatively larger observation angle than the glass sphere group B.

[5] The retroreflective sheet according to any of Claims 2 to 4, wherein
5 the proportion of glass spheres in contact with the surface layer is from 50 to 90 wt% of the total glass spheres.

[6] The retroreflective sheet according to any of Claims 1 to 5, wherein the refractive index of the glass spheres is within a range of at least 2.10 and no more than 2.40.

10 [7] The retroreflective sheet according to any of Claims 1 to 6, wherein the glass spheres have a median diameter within a range of at least 35 μm and no more than 75 μm , and at least 80% of the glass spheres have a median diameter within a range of $\pm 10 \mu\text{m}$.

[8] The retroreflective sheet according to any of Claims 1 to 7, wherein
15 the main component of the resin that makes up the focusing layer is a polyvinyl acetal resin.

[9] The retroreflective sheet according to Claim 8, wherein the polyvinyl acetal resin is a polyvinyl butyral resin with a degree of polymerization of 500 to 1500.

20 [10] The retroreflective sheet according to Claim 9, wherein the polyvinyl alcohol units of the polyvinyl butyral resin account for at least 17 wt% and no more than 23 wt%.

[11] The retroreflective sheet according to Claim 9 or 10, wherein the glass transition point (T_g) of the polyvinyl butyral resin is at least 60°C and no
25 higher than 80°C.

[12] The retroreflective sheet according to any of Claims 9 to 11, wherein the hydroxyl groups in the polyvinyl alcohol units of the polyvinyl butyral resin have been crosslinked with an amino resin, and the focusing layer is

one that does not dissolve when immersed for 1 minute in toluene, for 1 minute in xylene, or for 10 minutes in methanol.

[13] The retroreflective sheet according to any of Claims 1 to 12, wherein the mixing proportions of the glass spheres and the resin weight of the focusing layer are such that the glass spheres account for 1.5 to 3.7 weight parts per weight part of resin.

[14] The retroreflective sheet according to any of Claims 1 to 13, wherein the focusing layer contains a non-silicon-based anti-foaming agent in an amount of 0.01 to 3.0% of the resin weight of the focusing layer.

10 [15] The retroreflective sheet according to Claim 14, wherein the non-silicon-based anti-foaming agent is an alkyl vinyl ether copolymer.

[16] The retroreflective sheet according to Claim 1, wherein the surface layer includes at least one coating layer, or at least one coating layer formed over a resin sheet, and the coating layer is a composition obtained by
15 blending at least one resin component selected from among fluoro-olefin copolymers containing a reactive functional group, polyester resins, alkyd resins, polyurethane resins, vinyl resins, and acrylic polymers containing a reactive functional group, and at least one curing agent selected from among amino resins, epoxy resins, polyisocyanates, and block polyisocyanates,
20 and/or curing catalyst.

[17] The retroreflective sheet according to Claim 1, wherein the surface layer includes at least one coating layer, or at least one coating layer formed over a resin sheet, and the outermost layer of the coating layer is a fluoro-olefin copolymer composition.

25 [18] The retroreflective sheet according to Claim 16, wherein the resin component of the coating layer is a fluoro-olefin copolymer containing a reactive functional group.

[19] An external illumination system, comprising a sign having a sign face

including the retroreflective sheet according to any of Claims 1 to 18, and an external illumination source,

wherein the distance from the illumination source to the sign face is within a range of at least 1 m and no more than 100 m.

- 5 [20] The external illumination system according to Claim 19, wherein the illumination source emits light that is incident on the sign face at an incidence angle of at least 0° and no more than 50° to the sign face, and

the sign face exhibits reflective performance of at least 0.07 at an observation angle of 35° when reference light A whose color temperature is
10 2856K is incident thereon at an incidence angle of 35°,

where "incidence angle" refers to the angle formed by the irradiation axis of projected light and the face center normal line of the retroreflective sheet, "observation angle" refers to the angle formed by the irradiation axis of projected light and the observation axis, and "reflective performance" refers
15 to a coefficient calculated from the following equation:

$$\text{retroreflective coefficient } R' = I/ES \cdot A$$

R': retroreflective coefficient

ES: illuminance (lx) on a plane perpendicular to the incident light when light is incident at a center position of a test piece

20 A: test piece surface area (m²)

I: calculated from the following equation at the luminosity (Cd) toward the observation axis produced by a test piece

$$I = E_r \cdot d^2$$

where E_r is the illuminance (lx) on a light receptor, and

25 d is the distance (m) between the test piece surface center and the light receptor.

[21] The external illumination system according to Claim 19, wherein, when reference light A whose color temperature is 2856K irradiates the sign

face from the outside, the reflective performance at an observation angle of 5° and an incidence angle of 50° is at least 0.5, and the reflective performance at an observation angle of 40° and an incidence angle of 50° is at least 0.055.